Making Stream of Production.

-12. Making Stream of Production for “small demand and constraint process”

Before going back to the company of Chris Wilkins, I would respond next 1 theme and 2 questions.

One is Heijunka.
One is the question regarding the Lean book (Lean Thinking).
Another one is the question of
Why lean management introduction to be failed?

Heijunka.

As I wrote in the Making stream of production-11, Heijunka is one of essential technique for TPS (one of method to realize Lean manufacturing).

I saw or heard the companies who purport to be the TPS introduced company. But I haven’t seen the Heijunka introduced company.

I have seen the companies who (calling himself) introduced the Kanban system.

But I haven’t seen the company who implement the Kanban system in linking with Heijunka.

Kanban system with no Heijunka? “Impossible”.

Heijunka is one of essential condition of the kanban system.

So what is Heijunka?

Heijunka (平準化 in Japanese): (In the Japanese dictionary)

To flatten. Or eliminate the unevenness.
In the production control, Heijunka is to “eliminate the unevenness of production (including supply and delivery).

Why Heijunka is necessary?

I have already explained the “Work load Heijunka (Production levelling)”.

Please look at following production schedule.

														Assembly Production Schedule														Month: Sep. 09'				
Part	SH				1	2	3	4	5			6	7	8	9	10			11	12	13	14	15			16	17	18	19	20		
No.	(KM)		(1).	(2).	3	4	5	6	7	(8).	(9).	10	11	12	13	14	(15).	(16).	17	18	19	20	21	(22).	(23).	24	25	26	27	28	(29).	(30).
A	0.1	150			30	30	30	30	30																							
		15.0			3.0	3.0	3.0	3.0	3.0																							
B	0.3	50										10	10	10	10	10																
		15.0										3.0	3.0	3.0	3.0	3.0																
C	0.3	40																	8	8	8	8	8									
		12.0																	2.4	2.4	2.4	2.4	2.4									
D	0.2	140																								28	28	28	28	28		
		28.0																								5.6	5.6	5.6	5.6	5.6		
Total		380			30	30	30	30	30			10	10	10	10	10			10	10	10	10	10			28	28	28	28	28		
KM.		70.0			3.0	3.0	3.0	3.0	3.0			3.0	3.0	3.0	3.0	3.0			2.4	2.4	2.4	2.4	2.4			5.6	5.6	5.6	5.6	5.6		
H A					375											→			300				→			700				→		
E(%)					95											→			95				→			95				→		
LHA					395											→			316				→			737				→		
A(%)					98											→			98				→			98				→		
PHA					403											→			322				→			752				→		

A company (quite big company) got the order of machine tools.

Machine tools A: 150 units. B: 50. C: 40. And D: 140. Total: 380.
The delivery dates are the next month (October).

The production control department made the assembly plan in the batch style production in the consideration of the efficiency of assembly and parts preparation factory as above.

First week: product A. And each day 30 units.

Second week: product B. And each day 10.

Third and fourth week also as above.

Is this batch production truly efficient?

Of course the answer is "No". Because.

The necessary head account in the line (LHA in the schedule diagram.) at the 1st and 2nd weeks is 395 workers.

But at the 3rd week, the LHA is 316 workers. Also 4th is 737.

Note) In here once again review the head account calculation.

Look at the 3rd of September.

It is necessary to produce the product A 30 units.

Standard hour (SH): 100 MH (man hour. 0.1 KMH).

Total necessary working volume in standard for 30 units/day =

30 x 0.1 = 3.0 KMH.

Actual working hours (in the assumption): 8 hours/day person.

Head account (HA) = 3,000 ÷ 8 = 375.

The efficiency (in the assumption): 95%.

The necessary head account in the line (LNA) = 375 ÷ 0.95 = 395.

The attendance ratio: 98%.

The planned necessary head account of assembly workers =

375 ÷ 0.95 ÷ 0.98 = 403.

If the product A is planned to produce in the independent line, the LHA is 375 workers. But for the 375 it is necessary to plan the head account of 403 which is considered the attendance ratio.

Then as you understand, if there are such unevenness between each week, the Muda of the labour force preparation.

If the production has the unevenness, it is necessary to provide the materials, machine & equipment capacity, labour capacity, space and control capacity for the "peak".

In fact this company was quite big. Therefore he could adjust the workers in the company total.

Even though he has the capacity in total, the labour force Muda should occur.

How about the parts preparation factory?

Was the factory manager happy?

If the factory has the special lines (Seiryuka line) of the parts for individual A, B, C and D products, and the machines are expensive, he shouldn't be happy.

Because (for example) after the parts production of A, this A parts Seiryuka line can't have the jobs during the parts preparation of B, C and D.

As I wrote, Toyota sacrifices the Muda of machines with the cheap and homemade machines for the Seiryuka line.

But this machine tools company needs the NC machines (Numerical Control machine) which are universal and expensive for the parts which are completely internal manufacturing.

This is the meaning of the Muda of machine capacity.

If the machines of Seiryuka lines are very cheap, the machine cost and the investment performance are forgettable.

But actually this company used NC machines which are very expensive.

Additionally the products and parts variation are many and small demand and also the takt time of the parts preparation is long. Therefore however it is possible logically to make the Seiryuka and special line, it is not realistic.

Again was the parts preparation factory happy?

Yes in fact he was happy because the batch assembly production requires the batch parts preparation which it is possible to reduce the changeover times.

And this factory had many NC machines which still took long minutes to the changeover.

And the factory manager wanted to have the large batch size as much as possible.

But on the other hand the material performance and cash-flow worsened.

In the managerial consideration, the machine performance and the material performance & cash-flow which is important?

Of course both of them are important and the compatibility with them is important.

Therefore the changeover time reduction activity in SMED is essential.

No Workload Heijunka creates these Muda in the assembly and parts preparation factories.

We look at the importance of Heijunka in another point of view.

The opposite state of Heijunka production is batch production which gather the production in one batch.

Why batch production is bad and why Heijunka production is required?

I have written that LT has 2 phases which are “Process LT and Material LT”.

If the batch production is made, both of process LT and material LT worsen.

Again look at the assembly production schedule of some famous machine tool maker (Page 1).

Note)

KM: KMH. HA; Head account. E; (Planned or actual) Efficiency.

A; Attendance ratio. LHA; Necessary head account of the line.

PHA; Planned Head Account.

Assumption.

The receiving orders of this factory were confirmed at the end of the last month and were

A product (100 MH/unit); 150 units.

B product (300 MH/unit); 50.

C product (300 MH/unit); 40.

D product (200 MH/Unit); 140.

Delivery date. (Individual demand is delivered in at once)
Product A; Oct. 6th.
Product B; Oct. 16th.
Product C; Oct. 20th.
Product D; Oct. 25th.
(Anyway next month)

The date of receiving order of product C was the Aug. 20th (last month).

The necessary PHA of the first week is 403 workers. This factory manager has planned to assemble these demand in batch production style for seeking better efficiency of the parts preparation and assembly.

The parts preparation of A, B, C and D are started at the middle of Aug (in the consideration of the te-ban).

In the last issue, I have described that LT (lead time) has 2 phases which are Process LT and Material LT.

And the answer for "Is Batch Production Bad?" is yes bad, because to worsen the both LT.

Process LT (supply and delivery)

Process LT (supply to next process) is the LT from the receiving order (production order) to the finish of the supply to the next process.

Process LT (delivery) is the LT from the receiving order to the finish of the delivery.

As you are aware of, the customer who made the order of C product is required to wait one month to gain the product.

On the other hand most of the necessary parts of C which are used the common materials and dies with A, B and D are started to provide at the middle of the Aug. These are necessary to wait and to stock until the assembly start of C product when is from the Sep. 11th.

And other unique parts of C product should be started after the parts preparation of B.

(The problem of material stagnation.)

※ Process LT can be 0 in having inventory and WIP.

But having inventory and WIP cause the material stagnation and the worse material LT.

If the demands are predictable, it is possible to have the parts inventory.

And if the factory has the parts inventory (in the prediction) like as "store of kanban system", the parts preparation LT (process LT) can be near to 0.

Delivery LT also is possible to 0 if he has the inventory of the finished goods.

Material LT

Material LT is the lead time from getting the parts or materials (from supplier) to the finish of the product delivery (to the customer).

From getting parts or materials; Occurrence of payment.

Finishing delivery; gaining payment (even though by draft)
The LT from the purchase order (to supplier) to get these is the process LT.

If the factory has parts or material inventory and WIP (work in progress), (as I wrote above) the process LT (parts or material preparation LT) can be 0. However, the material LT worsens which means the cash-flow worsens because of the WIP and inventory (material stagnation).

In fact, it is not possible to be 0 material LT (not the process LT), because the cycle time (not the takt time) of each process is different.

(cycle time; speed of the process. From the start of one production to finish.)

For instance the cycle time of large press (in the lot size of 10) is 5’10”.

(Changeover; 5 minutes. Net press time; 10 seconds).

And the assembly cycle time is 1 minute.

(In the assembly line of a car manufacturer)

There are 4’ 10” difference between each cycle time.

And as the production process, it is necessary to supplement the difference.

Then it is necessary to have the WIP.

There are the cases of having the finished goods inventory for quick response to the customer. This case also quite natural and general in a business.

Of course having inventory and WIP create worse material LT and cash-flow.

But in some cases, it is necessary.

And it is also necessary to make effort to minimize both process and material LT.

Going back to the theme

“Why batch production is bad and why Heijunka production is required?

Long years ago (before learning TPS) my previous company also had been doing the batch style production because of seeking for better labour efficiency, for considering the efficiency of expensive machines, for better material efficiency (reduce scrap) and the (fake) benefit in financial accounting.

※ It is quite true that there is a factor of reducing scrap in large batch size because of the changeover frequency reduction and reduction of trial before start production. But the influence of large batch is worse than this benefit.

Efficiency.

The gemba wanted to produce the products in batch style.

And we believed that it is possible to improve the efficiency in batch production because of the changeover frequency to be reduced.

There was (or still “is”) the word of “Economic batch size”.

But we realized that the betterment of efficiency was fake.

At that time my previous company’s level was the large batch size in still poor level of quality.

And as the result of large batch size with poor quality control, the image of the production was “making a lot and discarding a lot”.

The WIP and stock yard were always overflowing.

In spite of many WIP, the assembly lines stop occurred frequently.
Sometimes the immediate re-preparation of the circuits were required because the defective circuits were found in the assembly lines.
In the warehouse, many finished goods were waiting for the amount sold.
In the parts preparation factory, also large batch production infested and caused the longer process LT, because of waiting the production start and the conflict & waiting of expensive die tools in the machine area.
And our division needed to calculate a lot of scrap losses.

Again what is efficiency?

Efficiency (labour) = (∑output x ST ÷ actual MH) x 100
And what is output?

- Output volume of individual process?
- No. it is wrong.
- The output in efficiency calculation should be the production volume which was "sold (or used by next process)".

The batch production in the assembly process requires the batch production of the parts preparation in the machine area.
(This batch wave infects to the production of suppliers and has the characteristic of amplification.)
The machines were very expensive.
And it was required to improve the machine performance ratio.
The parts which were unexpected to sales were never produced, but the preceded production for seeking larger batch size infested and was allowed.
The parts which were unexpected to sales were never produced, but as the result many obsolescence occurred.
My company implemented not only the financial accounting but also the managerial accounting.
And each manager was required to improve the performances in managerial accounting. But as I have written before, managerial accounting also not the perfect system and has the defect which is to fall in the "Part Optimum".

Assembly manager required to produce in batch production for better assembly (labour) efficiency.
(However the sales department required shorter delivery date.)
Parts preparation factory manager required larger batch size for seeking better labour and machine efficiency. (However the parts produced stagnated long days in WIP yard or storehouse.)

Therefore the general manager was required to find the situation of "Part Optimum" and to correct it for the "Entire Optimum" in the managerial accounting report and behaviour of the managers.
In the TPS project, the top management decided the factory evaluation KPI (key performance index) and the priority.

(Shorter) LT, (Smaller) Batch size, Changeover time (in SMED) and frequency, Inventory turnover (cash-flow) and Efficiency.

(Omit the writing up of other KPI; Safety, Kaizen suggestion etc.)

In the monthly management review meeting, the cash-flow also are evaluated.

For the evaluation of cash-flow in gemba, we decide to see the inventory turnover of each factory and entire.

"Inventory turnover" =

Sales amount ÷ actual inventory.

Actual inventory: Raw material, WIP and Finished goods.

Note) Cash-flow.

Financial accounting has 3 documents which are Balance sheet, Income statement and Cash-flow Statement.

And Cash-flow statement which shows the flow of the money has 3 materials which are Operating cash flow, Investment cash flow and Financial cash flow.

These are important to know the situation of cash flow, however, it is quite difficult to use in production gemba monthly (or weekly) bases.

On the other hand the largest factor in cost is material. (Depending upon the business, the ratio is different. For instance in a Mexican factory, direct labour cost was 18% and the material cost was more than 60% to the total cost.)

Also finished goods or WIP whatever, these are added the values to the materials.

Then as the index of cash-flow in gemba, I decided to see the inventory turnover.

It is important to grasp the inventory and WIP stock monthly (and weekly) bases. Is it difficult to implement the monthly inventory check?

Long years ago and when our project worked on the introduction of TPS, it was difficult because there was no infrastructure of computing system for gathering data.

But now (I believe) it is possible to gather the data and calculate the inventory turnover daily bases.

But if still it is difficult, I recommend to use the simplified method which is to use the basic (standard) unit cost.

This simplified method is not possible to require high accuracy. But it is enough to use for the benchmarking and the target control in gemba.

Again I feel that Taiichi Ohno is and was a great person.

At that era (or now also in the backward company.) the common-sense to improve the factory's performance was batch production.

For the (fake) improvement of machine performance, to gather the working lot as much as possible was a common-sense.

For the (fake because of worsened cash-flow.) improvement of material efficiency, to gather the working lot was the common-sense.

For the (fake because of worsened labour utilization ratio.) improvement of labour efficiency, to gather the working lot was a common-sense.

And in many dissent, T. Ohno (and Shigeo Shingo) proposed

JIT in Heijunka production in minimizing batch size (in SMED) and in mixed production.

It was the epoch-making philosophy.

Note) Is batch production bad and is Heijunka in small batch & mixed production good?

In the wiring harness production I wrote that 1 car (for instance Corolla) has about 1,500 electric circuits. Also those are all unique parts (not possible to use for other kind of car).

Now let us consider the difference of parts preparation process and assembly process.

Assembly process is basically one by one production flow. On the other hand is it possible to make 1 by 1 production in the circuits (unique parts) preparation factory (machine factory)?

The answer is no and not realistic. Of course theoretically it is possible but not realistic. Why? The key of consideration is the Takt Time (not the cycle time).

The takt time of Corolla is 1 minute. (In the Toyota TAKAOKA plant in Toyoda city)

The meaning of 1 minute takt time is that all 1,500 unique circuits also are required to produce within 60 seconds. For realizing and synchronizing, how is it possible to do?

In here I show the example of changeover procedure and the job of the cut & crimp automatic machine.

1) Take off the cable coil from the supply stand and clear.
2) Put the next cable coil in the supply stand for the next production.
3) Feed the cable in the pass line to the machine.
4) Take off the terminal reel from the supply of crimping machine and clear.
5) Put the terminal reels in the supply for the next production.
6) Set up the cutting length and strip length (insulation of lead ends)
7) Inspect the length and strip length (each kind of terminal has different standard strip length).
8) Crimping height setting.
9) Crimping inspection, (Alternative characteristic for electric contact are the crimp height and terminal fitting strength.) and record.
10) Start of production and first visual inspection.
11) Final visual inspection and packaging.

And the changeover time (process 1~9) is 8 minutes (Single DANDORI.).

One circuit production is (average) 1 second.

Takt Time is the tool to synchronize the relevant processes.

One circuit preparation: 8'01".

Corolla Takt Time: 1' in one piece flow.

It is possible to produce in minimized batch size, but is no realistic to implement 1 by 1 in machine factory.

It is necessary to implement the WorkLoad Heijunka in machine factory.

And as a machine factory, the activity of the Production Kinds Heijunka means to challenge the increase of changeover frequency in SMED.

On the other hand both work load and kinds Heijunka should be implemented in assembly process in the 1 by 1 production flow.

Heijunka implementation.
Now how to implement the Heijunka production plan?
Again Heijunka has 2 steps which are

Workload Heijunka (Production levelling) and
Production kinds Heijunka.

This machine tools assembly factory made the above production schedule. (P-1)
The assembly production order of this month was

A: 150. B: 50. C: 40. D: 140. (20 working days and 8 hours/day = 480 min working hours/day)

As the assumption, these are produced in one production line (like as car assembly line).
One line or 4 individual lines?
One line is better (if the space is allowed), because of the space efficiency and the improvement of the labour efficiency).
1) Workload Heijunka in the month.

As you understand the weekly batch production requires the labour forces of 1st and 2nd week: 395 workers. 3rd week 316. And 4th week 737.
In such labour force requirement causes the Muda of the labour force.
Therefore it is necessary to implement the "Workload Heijunka".

Look at the modification of the assembly production schedule.
From.

														Assembly Production Schedule														Month: Sep. 09'				
Part	SH				1	2	3	4	5			6	7	8	9	10			11	12	13	14	15			16	17	18	19	20		
No.	(KM)		(1).	(2).	3	4	5	6	7	(8).	(9).	10	11	12	13	14	(15).	(16).	17	18	19	20	21	(22).	(23).	24	25	26	27	28	(29).	(30).
A	0.1	150			30	30	30	30	30																							
		15.0			3.0	3.0	3.0	3.0	3.0																							
B	0.3	50										10	10	10	10	10																
		15.0										3.0	3.0	3.0	3.0	3.0																
C	0.3	40																	8	8	8	8	8									
		12.0																	2.4	2.4	2.4	2.4	2.4									
D	0.2	140																								28	28	28	28	28		
		28.0																								5.6	5.6	5.6	5.6	5.6		
Total		380			30	30	30	30	30			10	10	10	10	10			10	10	10	10	10			28	28	28	28	28		
KM.		70.0			3.0	3.0	3.0	3.0	3.0			3.0	3.0	3.0	3.0	3.0			2.4	2.4	2.4	2.4	2.4			5.6	5.6	5.6	5.6	5.6		
H A					375											→			300				→			700				→		
E(%)					95											→			95				→			95				→		
LHA					395											→			316				→			737				→		
A(%)					98											→			98				→			98				→		
PHA					403											→			322				→			752				→		

To.

														Assembly Production Schedule														Month: Sep. 09'				
Part	SH				1	2	3	4	5			6	7	8	9	10			11	12	13	14	15			16	17	18	19	20		
No.	(kM)		(1).	(2).	3	4	5	6	7	(8).	(9).	10	11	12	13	14	(15).	(16).	17	18	19	20	21	(22).	(23).	24	25	26	27	28	(29).	(30).
A	0.1	150			9	9	9	9	9			9	9	9	9	9			6	6	6	6	6			6	6	6	6	6		
		15.0			0.9	0.9	0.9	0.9	0.9			0.9	0.9	0.9	0.9	0.9			0.6	0.6	0.6	0.6	0.6			0.6	0.6	0.6	0.6	0.6		
B	0.3	50			2	2	2	2	2			2	2	2	2	2			3	3	3	3	3			3	3	3	3	3		
		15.0			0.6	0.6	0.6	0.6	0.6			0.6	0.6	0.6	0.6	0.6			0.9	0.9	0.9	0.9	0.9			0.9	0.9	0.9	0.9	0.9		
C	0.3	40			2	2	2	2	2			2	2	2	2	2			2	2	2	2	2			2	2	2	2	2		
		12.0			0.6	0.6	0.6	0.6	0.6			0.6	0.6	0.6	0.6	0.6			0.6	0.6	0.6	0.6	0.6			0.6	0.6	0.6	0.6	0.6		
D	0.2	140			7	7	7	7	7			7	7	7	7	7			7	7	7	7	7			7	7	7	7	7		
		28.0			1.4	1.4	1.4	1.4	1.4			1.4	1.4	1.4	1.4	1.4			1.4	1.4	1.4	1.4	1.4			1.4	1.4	1.4	1.4	1.4		
total	Prod	380			20	20	20	20	20			20	20	20	20	20			18	18	18	18	18			18	18	18	18	18		
total	MH	70.0			3.5	3.5	3.5	3.5	3.5			3.5	3.5	3.5	3.5	3.5			3.5	3.5	3.5	3.5	3.5			3.5	3.5	3.5	3.5	3.5		
HA				437.5																												
E(%)				95																												
LHA				460.5																												
A(%)				98																												
NHA				469.9																												

For instance the 3rd of Sep.

Product A: 9units and 900MH. B: 2 and 600MH. C: 2 and 600MH. And D: 7 and 1,400MH.

Total production/day: 20units and 3,500MH.

Then the daily production KMH (kilo man hour) is 3.5KMH in standard hours.

And the necessary head account in the efficiency is 461 workers.

For instance the 11th of Sep.

Product A: 6 units and 0.9KMH. B: 3 and 0.9. C: 2 and 0.6. And D: 7 and 1.4.

And as the total 3.5KMH is kept.

Then the Workload Heijunka is done. Next each day.

2) Kinds Heijunka.

Next. It is necessary to make the Kinds Heijunka in each day.

When looking at the monthly workload Heijunka (above diagram), for instance

A: continues 9/day production during 10 days. Then 6 in 10 days.
B: 2/day in 10 days and 3/day in 10 days.
C: 2/day during 20days.
D: also 7/day during 20 days.

Then it is necessary to minimize the variation of the production numbers because of minimizing the valuation of Kinds Heijunka pattern.

Above example has 2 patterns: 9-2-2-7 and 6-3-2-7.

In this case the Heijunka pattern change point is the 11th.

Now it has already been finished the workload Heijunka.

Then next. It is necessary to decide the production order of each day in the Kinds Heijunka. And it is to decide the production order of A, B, C and D.

Now let's look the daily Kinds Heijunka in the case of the 3rd of Sep.

-1. If.

	Production Order																			
P. Cycle	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
P. Order	A	A	A	A	A	A	A	A	A	B	B	C	C	D	D	D	D	D	D	D

If the working order is decided as above, still it is the batch production which require the WIP in excess.

P. Cycle: Production cycle. P. Order: Production order.

Then it is necessary to distribute the working order in kinds Heijunka.

-2. Distribute in the ratio of 9: 2: 2: 7.

I explain the simple method in the use of takt time.

Total production: 20.

20 in 480min: (480 ÷ 20 =) 24 minutes cycle production.

About 25 (where it is convenient.)

Firstly biggest Takt Time is distributed. (C or D: 240 min)

	Production Order																			
P. Cycle	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Off line	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500
timing										C										C

Next to distribute B (240 min) as below.

	Production Order																			
P. Cycle	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Off line	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500
timing									B	C									B	C

And next to distribute D (68.6 min and about 70 min).

	Production Order																			
P. Cycle	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Off line	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500
timing			D			D		D	B	C	D			D			D	D	B	C

And finally A is filled in the blank remained.

	Production Order																			
P. Cycle	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Off line	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500
timing	A	A	D	A	A	D	A	D	B	C	D	A	A	D	A	A	D	D	B	C

Still there are continuous production of A, A and D, D.

To make working standards (Standardized Work Combination Table, Standardized Work Chart and Job Instruction Sheet), it is necessary to minimize the pattern.

In this case

A to A, A to D, D to A, D to B, B to C, C to D, D to A and D to D.

Total 8 patterns for each process are necessary.

Then to make a little modification as below.

※ 500? Over the 480 minutes? It is no necessary to think severely. This method is mere deciding the production order.

And (next diagram) start the production in the order of
A to A. A to D. -----.

							Production Order													
P. Cycle	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
P. Order	A	D	A	D	A	D	A	B	C	A	D	A	D	A	D	A	D	A	B	C

In this pattern.
To make the working standards for each process.
A to D, D to A, A to B, B to C, C to A.
Total 5 patterns are necessary.

-3. Necessary head account calculation in takt time.

I already showed the calculation method in the standard time and the actual (or planned) efficiency.

And also I have shown the head account calculation with "Takt Time" in the "Making stream of production-4".

In here once again let us confirm the necessary head account in the takt time.

The efficiency of each product was
A: 96.0%. B: 97.3%. C: 93.5%. D: 94.0%. And Average: 95.0%.

	Prod.	Takt Time	SH	E	MH	NMH	LHA	Att	NHA
Prod.	U/day	Min	Hour	%	H/Unit	MH		%	
A	9	53.3	100.0	96.0	104.2	937.5	117.2		
B	2	240.0	300.0	97.5	307.6	615.2	76.9		
C	2	240.0	300.0	93.5	320.9	641.7	80.2		
D	7	68.6	200.0	94.0	212.8	1489.4	186.2		
AV		24.0		95.0	184.2			98.0	
total	20					3684.0	460.5		470

Takt Time of A = 480 min/day ÷ 9 units/day = 53.3 minutes.
B: 240. C: 240.
Takt Time of D = 480 ÷ 7 = 68.6 minutes.
Average Takt Time = 480 (8h/day x 60 min) ÷ 20 = 24.0

Head account calculation in Takt Time = Actual MH ÷ Takt Time.
Actual MH of A =100.0 MH ÷ 0.96 efficiency = 104.2 hours/unit.
Actual MH ÷ Takt Time = 104.2 x 60 min/h ÷ 53.3 = 117.2.
C = 300.0 MH ÷ 0.935 = 320.9
Actual MH ÷ Takt Time = 320.9 x 60 ÷ 240 = 80.2.

Head account calculation in line (LHA) total =
117.2 + 76.9 + 80.2 + 186.2 = 460.5

Necessary Head Account (in plan) = 460.7 ÷ 0.98 attendance ratio (Att) =
470 workers.

Now as you understand the necessary head account calculation results in the standard time (standard hour) and in takt time are same.

Takt Time = 480 min/day ÷ Necessary production.
Total HA = Actual MH ÷ Takt Time
= 184.2 (average MH: actual) x 60 ÷ 24.0 (minutes) = 460.5

In other words, necessary head account is how many workers are necessary for realizing the "actual man hour which is the same meaning of actual work load" in the necessary work speed which is the Takt Time.

-4. Line formation.

After the Heijunka production plan, it is necessary to make the line. And for the line formation in mixed production, following steps are required.

a) Deciding the Takt Time (cycle time also same meaning in this time).

b) Making the Workload Heijunka in each day in the month.
    And making Kinds Heijunka in each day.
    (Deciding the working order.)

c) Deciding the number of the process and workers.

d) Making the working standards.
    Standardized Work Combination Table.
    Standardized Work Chart. And
    Job Instruction Sheet.

e) Line formation.
    (Setup of the line and machine & tools.)
    (Distribution of the workers.)
    Training with the Jib Instruction Sheets.

f) Line balance check.

c) Number of processes and workers.

The necessary total work load = 3,500 MH/day in the standard time. And
The average efficiency = 95%.
Then total workload in actual efficiency = 3,500 ÷ .95 = 3,684.2MH.
To realize this workload, the necessary head account =
3,684 ÷ 8 = 460.5 workers.
Therefore 3,684 MH workload is distributed to 461 (460.5) persons.
The number of processes is equal to the number of workers.
461 processes.
Now. If
If the demand reduced from total 20 units/day to (for instance) 13.
A: 4. B: 2. C: 2. and D: 5. and total 13.

	Prod	Takt Time	SH	E	MH	NMH
Prod	U/day	Min	Hour	%	H/Unit	MH
A	4	120	100.0	96.0	104.2	416.7
B	2	240	300.0	97.5	307.6	615.2
C	2	240	300.0	93.5	320.9	641.7
D	5	96	200.0	94.0	212.8	1063.8
AV		36.9				210.6
total	13					2737.4

The Takt Time = 480 ÷ 13 = 36.9 minutes.
AV of actual MH/unit = 210.6 MH.
Then

Necessary head account and number of processes

= 210.6 x 60 ÷ 36.9 = 342.4 persons.

※ 342.4 persons? Not exist 0.4 persons.

How can you do? 2 ways.

One is to reduce 0.4 persons in kaizen.

One is to distribute 343 persons.

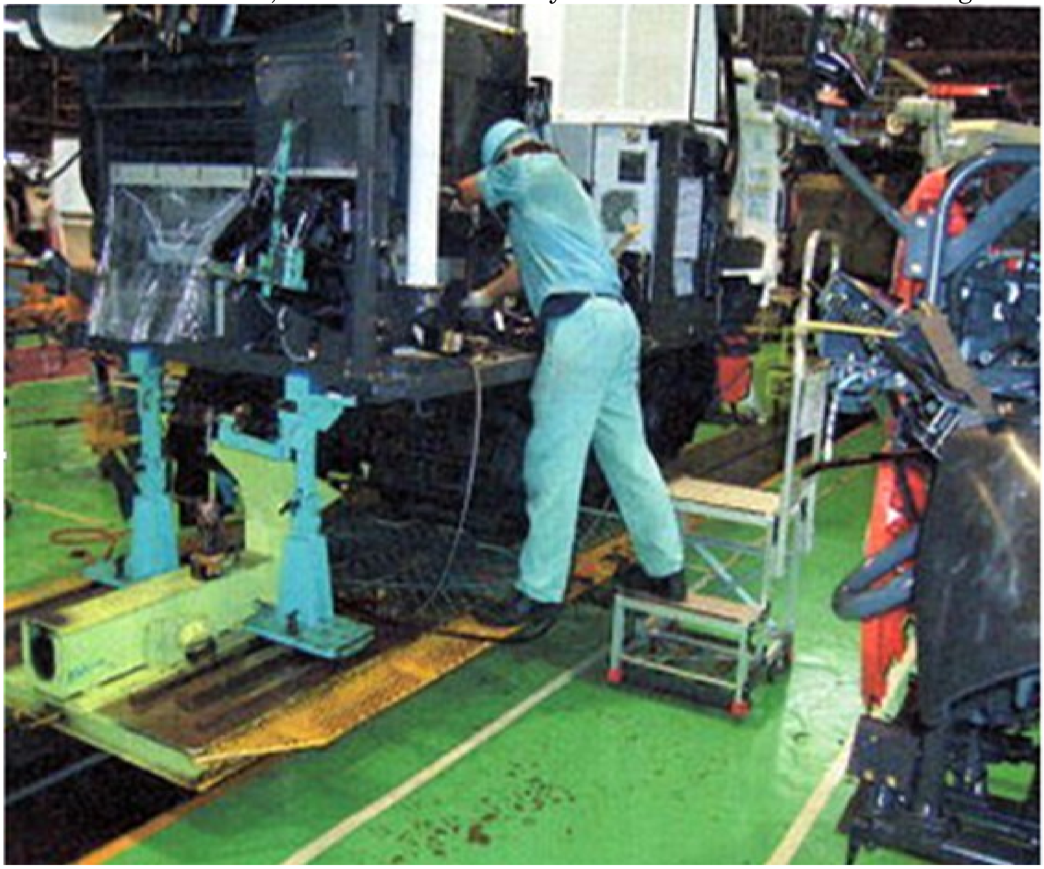
(Or 343 and the line leader helps when delay.)

The number of process is changed from 461 to 343.

And it is necessary to revise the Standardized Work Combination Table and the Standardized Work Chart.

e) Line formation.

If making these products in one mixed production line, as the photo below, and if it is necessary to have 3 meter each working area/person,



3 meter x 461 processes = 1,383 meters long line (at minimum) is necessary.

If 2 workers in one process, 691.5 meter long line is required.

f) Line balance.

Identify and list up of Work elements. Time study.

Combination of Work elements. And.

Making the working standard for each process.

It is same to make the Standardized Work Combination Table.

Working standard is essential. And the case of Toyota line, the line leaders and supervisors make these standards (not by the IE staffs, engineers).

-5. Delivery Heijunka.
Heijunka production is essential for the kanban system (if you wish to introduce) and is efficient for better cash-flow.
But it is desirable to forward the delivery Heijunka.
In the internal Production Heijunka, it is possible to improve the cash-flow in the reduction of WIP & Inventory.
But if the customer requires the batch delivery (delivery at once) and the finished goods are stored in the warehouse, it is not possible to record the amount sold until the delivery date.
It is necessary to give the importance to the customer's requirement, however, it is also important to make the discussion about the delivery Heijunka with the customer.
There is the case of bulk delivery for the shipping schedule of the export.
On the other hand there is the case of Heijunka delivery in partial delivery to be welcomed.
-6. Basic condition.
For the Heijunka (Kinds Heijunka) production in mixed production line, next conditions are essential.

- Skill Training.
  As you understand, if the demand is reduced, the head account also is reduced. And in the reduced number of workers, it is required to build the products.
- Making common jigs & tools.
- Standardization.
- Group Work.
- Cellular production technique.
- Production planning skill of Workload and Kinds Heijunka.
- Delivery Heijunka.

Essentially it is necessary to describe the method of line establishment (for instance conveyor line) in the column of the line formation.
However I would omit this because the main theme of this description is the Heijunka. And I would describe the line establishment in another opportunity.

-The possibility of Heijunka-1.
Again Heijunka has 2 processes.
Workload Heijunka (Production levelling) and
Production kinds Heijunka.
To consider the possibility of Heijunka introduction, I separate the 2 areas which are
Parts preparation process (machine process) and
Assembly process.

As I wrote, Production Kinds Heijunka requires the minimum lot production for instance one by one in the mixed production in a line.

Parts preparation process.

Workload Heijunka.

In machine process, it is essential to implement the work load Heijunka. And I wrote the method in the Making Stream of production-11.

Therefore I omit to make the comment in here.

Production kinds Heijunka.

Of course it is necessary to mix the kinds of production in the production order and the takt time required.

But this is purely the issue of minimizing lot size in SMED activity.

And however, it is possible and ideal to seek one kind by one kind production, it is not realistic, because of the necessary number of machines, investment performance and space.

It is possible to reduce the changeover time, but not possible to be 0.

Assembly process.

Assembly process is basically one by one production even though same kinds of production are continued.

And it is required to produce one by one production in the takt time required in the same production line.

(In the same line?)

To realize the Heijunka in one by one and mixed production there are some conditions.

To think the conditions let’s look some assumptions.

One assumption. TOYOTA Lexus in Corolla assembly line.

If it is planned to assemble Lexus in the corolla assembly line, what preparation is necessary?

The parts and chassis of Corolla and Lexus are completely different. And after few Corollas, one Lexus is assembled (based on the different takt time.)

Is it possible to assemble Lexus in the Corolla line as mixed production?

Yes it is possible logically. But it is not realistic. Because.

1) The chassis is different which means to be necessary to prepare special dollies for Lexus in the line.

    Longer assembly conveyor and space etc. are required.

2) Dual parts place of Lexus and Corolla in the line side.

    Also welding robots, assembly assist robots, tools etc.

3) Difficulties of 3 standards (plus one).

    3 standards: Standardized work chart, Standardized work combination table and Process capability table.

    Plus one: Job instruction sheet (for training).

Do you remember these standards which I wrote in the Making Stream of Production-4?

These standards are necessary for assembly process also.

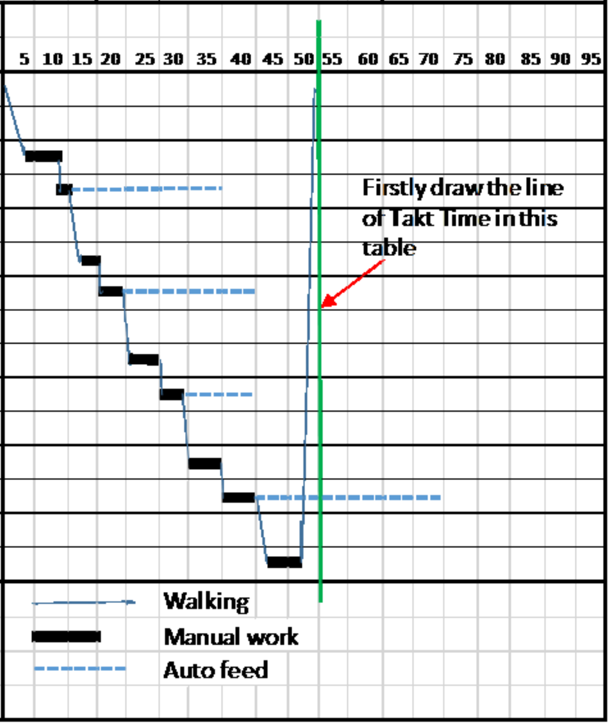
For instance Standardized Work Combination Table in the condition of mixed production (after few Corollas, one Lexus is assembled.).

The line workers are required to work in same cycle time (not the meaning of same number of workers.).
Corolla job, Corolla job ---- and to Lexus job. How to the workers combine the work elements?
The key is this Standardized Work Combination Table and other 3.
It is possible to make however, it is not realistic. No?
Now once again 4 standards as below. (From Making Stream -5 & 6.)

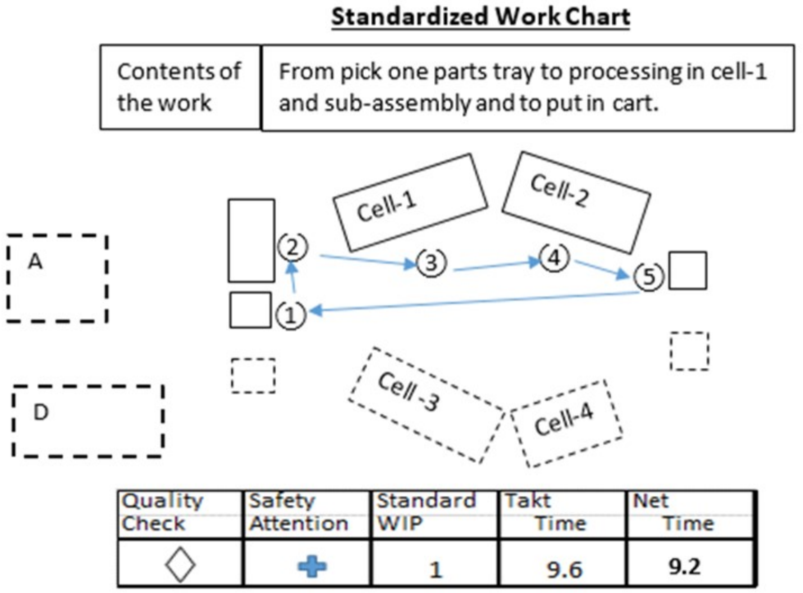
Part No	12345-678910	Standardized Work Combination Table	Production Date	Ago. 06'	Quantity: 552
Process name; Machining			Dep.	Parts Production	Takt Time: 50"

Pro. No	Work Name; Chip out	Time			
		Manu	Auto	Walk	Cum
1	Take out 1material from pallet	1"			1"
				2"	3"
2	Take off from C-4 and check	4"			7"
3	Attach in C-4 and start-up	3"	25"		10"
				2"	12"
4	Take off from DR-K and check	4"			16"
5	Attach in DR-K and start-up	3"	21"		19"
				2"	21"
6	Take-off from Ch-1 and check	4"			25"
7	Attach in Ch-1 and start-up	3"	11"		28"
				2"	30"
8	Take off from Ch-2 and check	4"			34"
9	Attach in Ch-2 and start-up	6"	30"		40"
				2"	42"
10	Quality check	5"			47"
		37"		10"	

Net Working Hours/ day: 7 h 40 min: 27.600 sec
Takt Time = 27.600 ÷ 552 = 50"



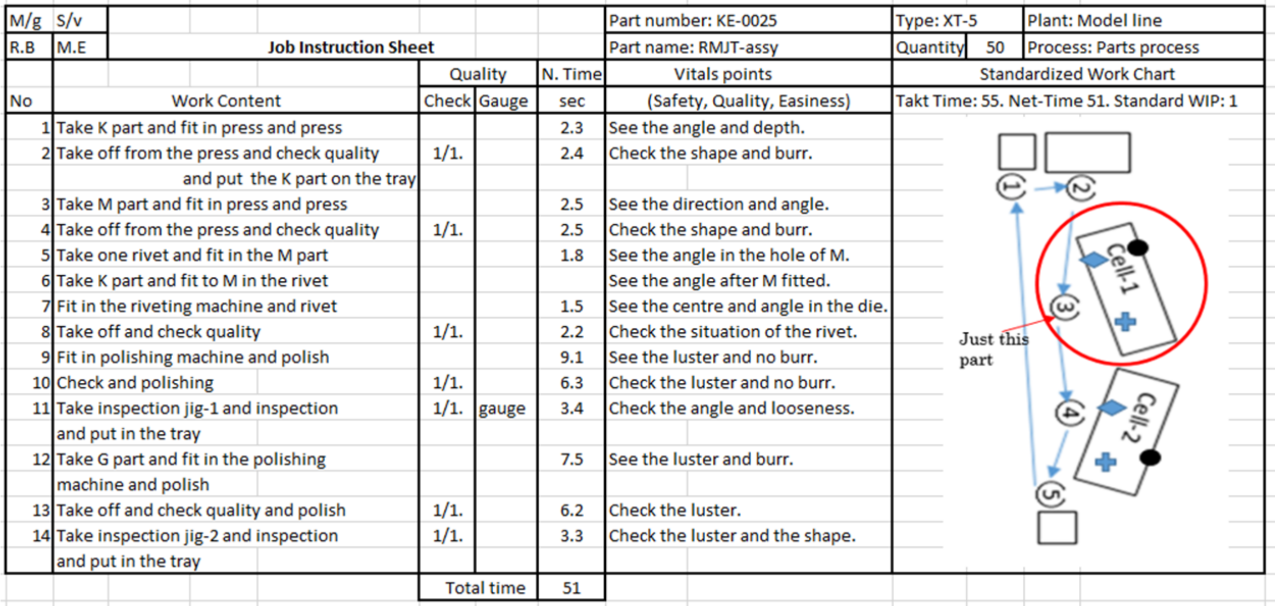
Approval		Process Capability Table	Part number: 12345-678910			Type: RX-75		Plant: Machining	
Manager	Supervisor		Part name: Hinge-A			Articles	1	Process: Hinge chip out	
J.D	M.K						By	Project	
Process	Process name	Machine		Basic Time		Cutting Tool		Prod.	Remarks
		No.	Manual T	Auto Feed T	Complete T	N of Change	Change T	Capacity	
1	Chip out from	C-4	3"	25"	28"	100	1'00"	966	
2	Make hole	DR-K	3"	21"	24"	1000	30"	1148	
3	Chamfer	Ch-1	3"	11"	14"	1000	30"	1967	
4	Finishing	Ch-2	6"	30"	36"	1000	30"	766	
5	Quality check	I-Hinge	5"	—	5"	—	—	5520	
				Working hour: 7h 40min = 460 min/day					
		total	20"						



Standardized Work Chart

Contents of the work	From pick one parts tray to processing in cell-1 and sub-assembly and to put in cart.

Quality Check	Safety Attention	Standard WIP	Takt Time	Net Time
◇	✚	1	9.6	9.2



M/g	S/v				Part number: KE-0025	Type: XT-5	Plant: Model line
R.B	M.E	**Job Instruction Sheet**			Part name: RMJT-assy	Quantity 50	Process: Parts process
		Quality		N. Time	Vitals points	Standardized Work Chart	
No	Work Content	Check	Gauge	sec	(Safety, Quality, Easiness)	Takt Time: 55. Net-Time 51. Standard WIP: 1	
1	Take K part and fit in press and press			2.3	See the angle and depth.		
2	Take off from the press and check quality and put the K part on the tray	1/1.		2.4	Check the shape and burr.		
3	Take M part and fit in press and press			2.5	See the direction and angle.		
4	Take off from the press and check quality	1/1.		2.5	Check the shape and burr.		
5	Take one rivet and fit in the M part			1.8	See the angle in the hole of M.		
6	Take K part and fit to M in the rivet				See the angle after M fitted.		
7	Fit in the riveting machine and rivet			1.5	See the centre and angle in the die.		
8	Take off and check quality	1/1.		2.2	Check the situation of the rivet.		
9	Fit in polishing machine and polish			9.1	See the luster and no burr.		
10	Check and polishing	1/1.		6.3	Check the luster and no burr.		
11	Take inspection jig-1 and inspection and put in the tray	1/1.	gauge	3.4	Check the angle and looseness.		
12	Take G part and fit in the polishing machine and polish			7.5	See the luster and burr.		
13	Take off and check quality and polish	1/1.		6.2	Check the luster.		
14	Take inspection jig-2 and inspection and put in the tray	1/1.		3.3	Check the luster and the shape.		
		Total time		51			

Let's look the Heijunka possibility in easier example.

Wiring harness assembly line.

My previous company implements Heijunka production in the wiring harness assembly line.

And the condition is “same group wiring harness”.

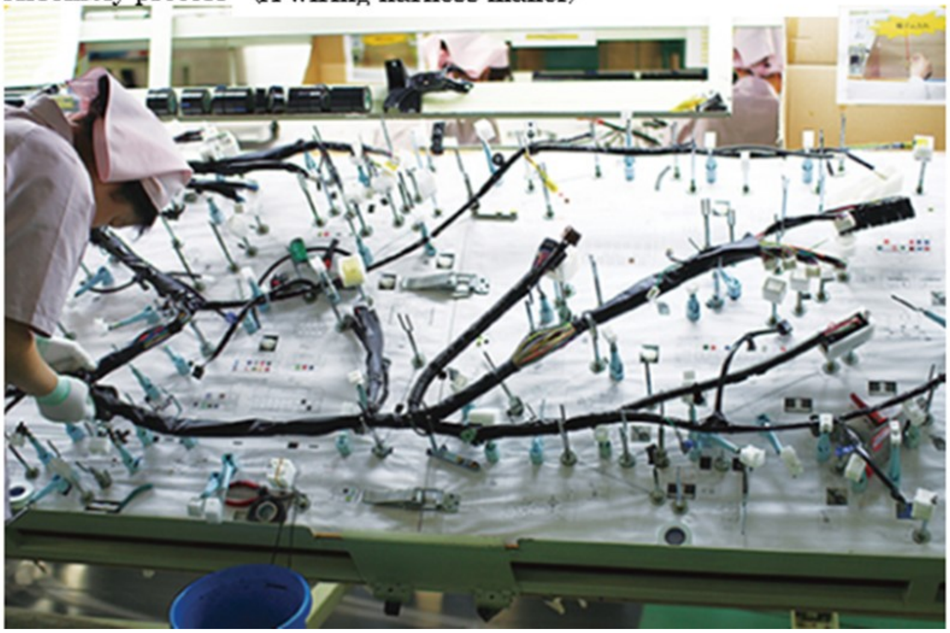
For instance Corolla has many variations as I wrote before. And each variation has its unique wiring harnesses. Then the wiring harness of Corolla also has many variations.

Many wiring harness variation, however, the major and main circuits are same. And in the assembly process, such unique circuits are added.
Of course there is the standard time difference between the wiring harnesses. And these standard time difference is not big and covered by the line leader or the forewoman.
And it was possible to omit to change the standards for the Heijunka and mixed production. Of course it should be made (ideally).
There is a constraint which is the workability.
Do you remember next photo which shows the gemba of wiring harness assembly with the jig board.

> (Just to be sure. It is not the gemba of my previous company. It seems to be not good workability.)

You can see many jigs on the board. These jigs are important to decide the dimensions.

Assembly process (A wiring harness maker)



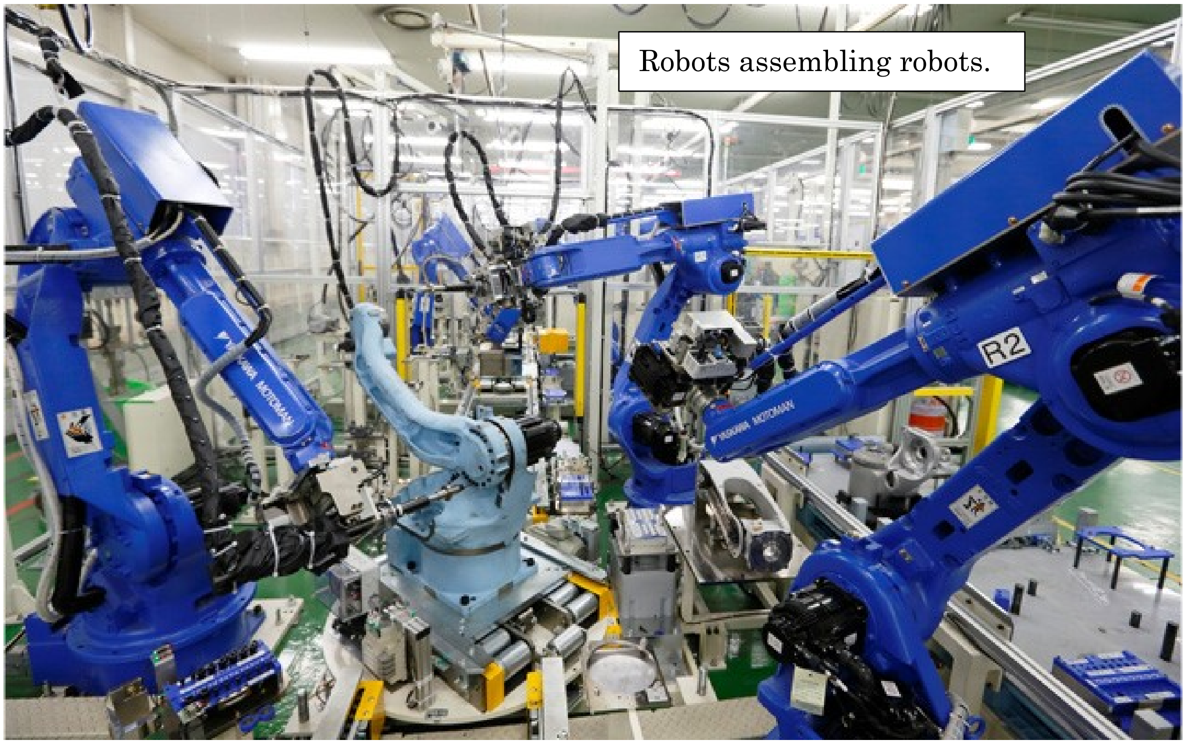
An example of assembly conveyor.
12 jig boards in the conveyor.
One worker or two workers in one board.
The jig board is not congested.
(Seems to be a simple wiring harness.)

Assembly conveyor

And one of key point for the workability is the number of jigs in one board. If all variation of wiring harness assembly in one board, the jig board is congested with the jigs and the work is disturbed.
It is natural to make the conveyor line production for large volume production. And to keep the workability, the number of jigs is limited, which means to be larger conveyor length.
Anyway it is not so difficult the Heijunka production in same group.
Another one assumption. Machine tools assembly job in Corolla line.
Let's consider additional assumption which is the machine tools assembly job in the car assembly line in Heijunka production also in mixed production.
Assembly parts are completely different. And.
Of course it is very much different the assembly method (necessary skill, jigs & tools and machines).
The demands are (assumption)

Corolla; 400/8hours. Takt time = 480 minutes/ 400 = 1.2 minutes.
Machine tools; 10/8 hours. Takt time = 480 minutes/10 = 48 minutes.
One machine tool is assembled in each 40 Corollas. And the cycle is repeated 10 times.

A machine tool maker in Japan.



In such condition (completely different products in one line), is Heijunka in mixed production possible?
Yes it is possible logically, but never reasonable and realistic.
It is quite true that it is better to make various products in one line rather than to provide individual line.
But in such case it is never reasonable.
(For large volume and repeated products, the independent line is better.)

From these examples it is possible to make clear the necessary condition for Heijunka and mixed production.

1) Similar products.
    Same technique, jigs & tools and machines are used.
2) Base of making 3 standards.
3) Or not much difference in the standard time.
4) Skill training, group activity (group work) and support system (group leader)

-The possibility of Heijunka-2.
Let's look at the possibility of Heijunka production from another point of view.
Now the company who can apply the Heijunka production is limited and not many because "The business background was changed".
When I learned and studied kanban system (in "pull system by Toyota. At the 1970s), the production background was still mass-production and also was the era to be possible to say "make and sell".

In such background the kanban system with Heijunka production was very much effected.

But now the business background has been changed and the characteristics are following 2 things.

-1. Products variation: Increase of the products variation. Instability of demand volume (in monthly and weekly). Unpredictable demand forecast.

-2. Short: Short LT required. Short product lifecycle.

In such background or products, is it possible to keep Heijunka production?

Weekly bases the production kinds and volume are changed. It means the difficulty of Heijunka planning, revising or renewal of the standards and also line training.

Yes indeed, it is difficult, however, it is essential for lean production in strong Gemba-ryoku (gemba capability) in well trained supervisor, foreman and leaders.

The cellular production system also one of solution.

Anyway it is necessary to make Heijunka. But (I know) it is difficult.

Incidentally, I would describe the possibility and the effectiveness of “Pull system” which is one of pillar of TPS.

Is kanban system in “pull” effective and/or possible?

Pull system needs to have “Stock (WIP and/or Inventory)".

To have the stock (even though to be controlled and minimized) worsen the Material LT and cash-flow and Throughput as well.

For keeping kanban system in pull, following 3 conditions are essential.

a) It is possible to implement the both of Workload Heijunka and Production kinds Heijunka.

b) It is possible to decide and control the stock in fixed quantity.

c) It is possible to continue the stabilized production in a certain period.

Heijunka production?

But at present there is not so much companies which it is possible to apply Heijunka planning in the production background because of the above reasons.

And most of the companies are annoyed by the increase of products variation, unstable & fluctuated & unpredictable demand and short life cycle.

But on the other hand the famous car industries (Toyota) and big companies can do Heijunka and kanban system.

Why they can do?

The big difference between Toyota and other general industries are

Toyota can decide his own production plan (and sales plan).

And Toyota can sell the cars which he planned.

Other companies (including medium and small) don’t have such capability and also products.

The Keiretsu of Toyota and the subcontract companies are happy, because they can be in the influence of the production plan of Toyota.

There is a case which the companies can decide their sales plan and also can sell as their sales plan.

Yes. If the companies have very attractive products and techniques which other companies can’t follow.

Is it possible to have the stock in fixed quantity?
To have the stock is the prerequisite condition for pull system, however, it is too risky to have fixed stock in the business background (short lifecycle, unknown and fluctuating demand).
Continuation of the production in certain period?
If the production demand can be continued and can be gain repeatedly in certain period for instance 6 months (car model change is normally 4 years), it is possible and better to use the kanban system.
But if it is not possible to expect the continuous demand, kanban system is not suitable means for lean management.
Send owls to Athens.
The kanban system is not suitable for the production process which has many kinds of parts and materials and many processes in one floor.
Yes. It is possible logically to implement kanban, but is not realistic, because of the complexity of control.
Many kinds of parts and materials and many process mean the necessity of many stock location (called store) and many stocks (WIP and inventory).
I like kanban system. And I recommend to use it in the good understanding.
(I will write more kanban in next opportunity.)

I finish the description of the theme of Heijunka.
And next. I respond to the questions.

Answer to question-1.
The question is as follow.

Does Pratt & Whitney (P & W) which is presented in the lean book as the example of Lean introduction implement value stream flow in the "parts preparation factory"?

Note: his saying "value stream flow means the short LT in minimized stock in the pull system.

And my answer is that I don't know.
I have neither visited the company nor seen the production gemba.
Therefore in the general theory, I write this answer as follow.
Changing the question to

a) Is it possible to do the kanban system in pull?
b) If yes. What is the advantage in LT? Cash-flow?
c) Is there the reality?

In the lean book there are example companies which introduced TPS successfully. But there is no description of the parts preparation process. As the process & production control, most difficult control is not the assembly, but the parts preparation process.
TPS implementation in P & W.
There is no description of the parts production process, however, it is very much interesting.

P & W is a famous Jet engine maker.
As the common sense, a jet engine has more than 3 million parts including the commercially available parts.

Even though excluding the commercially available parts, thousands of, millions of parts production are necessary. And those are supplied by the external suppliers who are the professional manufacturer of precise components. And I believe that Pratt & Whitney also doesn't produce all of the parts internally, but purchase those from the suppliers.

Now is it possible to produce all thousands millions parts internally? Logically, of course it is possible to produce with no procession of waiting if he has tens thousands of precise machines and also space. But it is not realistic.

Again I don't know this company, however, I believe that this company also uses many suppliers as the common sense.

Right then if use the suppliers of professional manufacturer of precise components, the jet engine company doesn't need to have many precise machines.

By the way

Currently the best seller aircraft in the world is Boeing 737. And Boeing assembles this about 35 per month (and now wishes to increase the production up to 47/month). And this aircraft uses the CFM-56 engine of CFM International.

CFM needs to produce 35 engines in a month which means that it is necessary to produce the engine in the takt time of 11h.

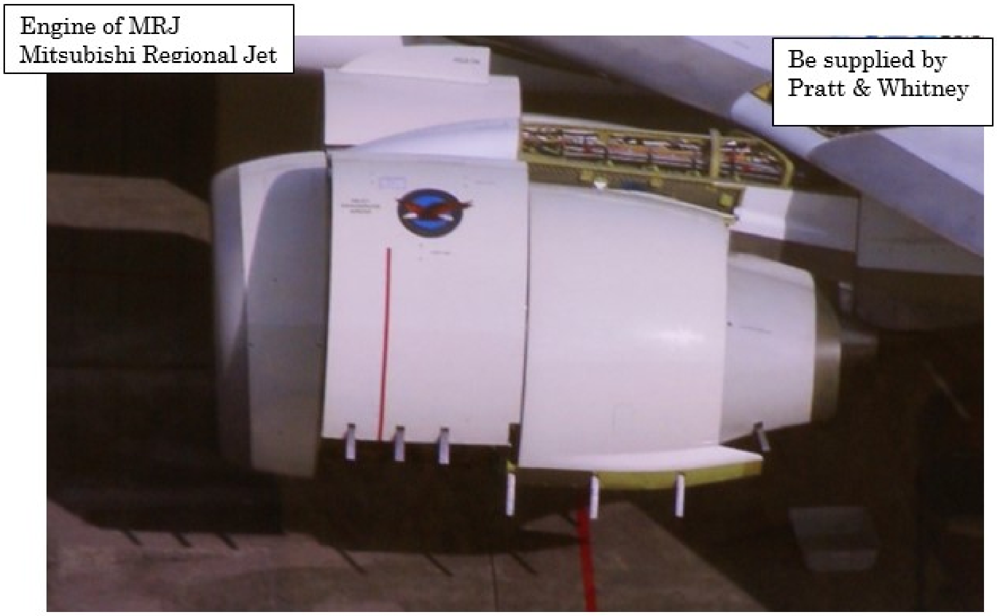
Assumption: 20 hours/day x 20 working days/month.

20 x 20 ÷ 37 = 11h.

Then thousands millions precise parts should be supplied in this takt time.

a) Is it possible to do the kanban system in pull?

Yes, the condition of this company (CFM) is allowed to introduce the kanban system in "pull" and it is possible to eliminate his inventory.



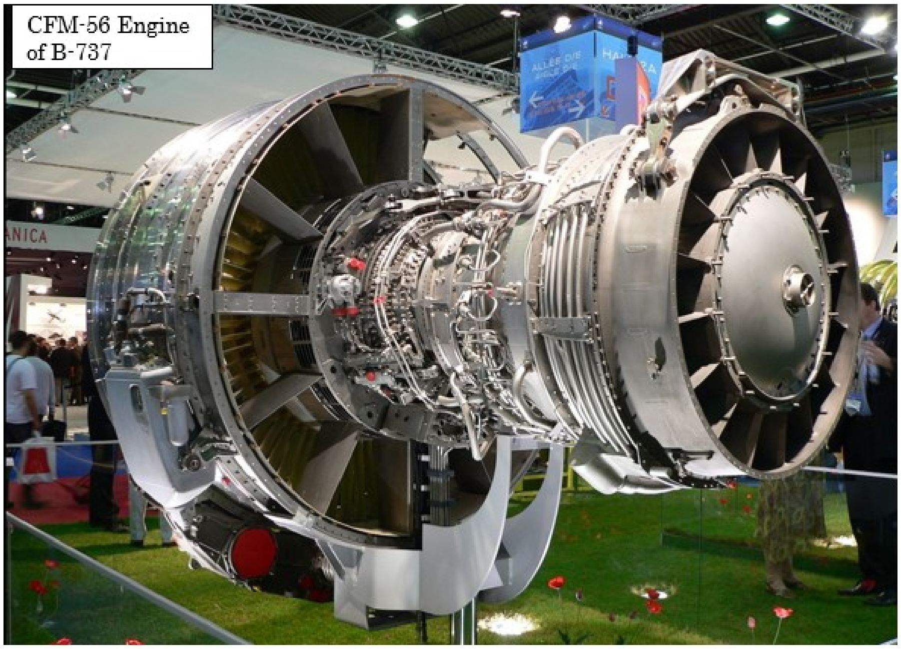
Engine of MRJ
Mitsubishi Regional Jet

Be supplied by
Pratt & Whitney

What is the essential condition of pull system?

The essential conditions of pull system are

Continuous demand in certain period.
The demand is predictable.
The fluctuation of demand is not big.


CFM-56 Engine of B-737

CFM which is an assembly maker.

It is possible to require the JIT supply in the condition of
Giving certain forecast to the suppliers.
Giving the guarantee of continuous demand in certain period.
The fluctuation of production order to be not big and minimized.
And it is possible to pull the necessary parts in kanban system.

The supplier.

How about the implementation of kanban system in the suppliers.
Yes. It is possible to apply the kanban system in the pull by CFM.
Because

a) There are continuous and predictable demand which continue in a certain period.
b) There are so many kinds of parts, however, the individual of parts production processes are never many and simple.
c) There are so many kinds of parts as total, however, are divided in many suppliers. Therefore (I guess) the share of one supplier is not many kinds.

If many processes in many parts kinds in one supplier, it becomes to be difficult to apply the kanban system in pull, because the increase of WIP or inventory in the "store" of each process increases the number of kanban kinds (and cards) and then increases the control difficulties.

Note) Again pull system.
Pull system is one pillar of kanban system and JIT.

It is required to have the “store” which is the location and the stock (inventory and WIP: work-in-progress).
B process pulls the necessary parts in the necessary quantity from the store.
A process produces and supplies the parts pulled in just the quantity pulled.
In having stock, it is possible to maintain the very short LT (Process LT) as JIT. However.
To have the stock worsens the Material LT, even though it is controlled and minimized.

b) If yes. What is the advantage? LT? Cash-flow? Throughput?
I believe that it is possible to apply the kanban system in both CFM and the suppliers for producing jet-engine parts.
Then if implement the kanban system in pull, is there the advantage against the one month batch production (each 37pieces /month).
The condition is “very small demand in a day (2 pieces each in a day).

Note) Again. What does Lean management seek?
In the Making Stream of Production-10, I wrote the purpose of the Lean management introduction as follow.

> The essence of Lean manufacturing is the activity of
> Approaching to the customer furthermore on the subjects of
> “Physical LT and True demand (and reasonable price).
> The meaning of “lean” is to be no flab and fat in the body.
> And the meaning of flab and fat are the excess inventory and WIP, excess capacity of labour and machine and bloated organization.”

Then.
What advantage do CFM and the suppliers gain? Yes? Or No?
Supplier.

Process LT. Yes, if the material supplier accept the daily delivery in the increased transportation cost, the time & effort of shipping inspection and the procedure.
Based on the above assumption, the parts supplier can have minimized inventory.

Material LT. Yes in the condition of above.
Cash-flow and Throughput. If the CFM accepts the daily receiving, the Cash-flow and Throughput can be gotten better.

What are the disadvantage?
If making 2 pieces in one lot which is still one day batch what is the disadvantage?

- As I have written before, the machine performance falls because of the increase of changeover frequency.
- In the increase of changeover frequency.
  Increase of various procedures for delivery.
  Shipping inspection & quality assurance data, Traceability records.

Note) Traceability record.
It is required to make records, storage and submission (to the customer when deliver) and is quite troublesome.

Normally the receiving inspection is omitted by the (for instance) Toyota based on the quality assurance contract and the certification system.

Instead of the receiving inspection, Toyota or CFM or P & W or whatever applies the quality assurance certification system with the regular audit and the compensation.

The component parts of the products which relate to the human life directly are required the traceability from the raw material, processes and to the finished products (sometimes up to the disposal).

And in each changeover which is the meaning of production condition change, it is required to renew the work & document with the "new lot number".

c) Is there the reality?

In reality can the kanban system be effective in the suppliers of parts production process of the jet-engine?

No. There is no reality. I don't know the suppliers of CFM or W & P, however.

There are some negative points. And one of the problem is the Occurrence of the worse machine performance" in the "Changeover time frequency (NC-machine, Machine Tools, Furnace & Anneal etc.)".

Toyota can do because

Cheaper (and homemade) machines.

Production volume is quite large (the takt time is 1 minute).

(The condition of Continuous and predictable demand in certain period are same to the case of CFM.). But.

The machines & equipment of the suppliers are still batch characteristic because of the changeover and the prices.

In reality, the changeover time is never near to 0. And the supplier needs to calculate the possible work load capacity in the condition of batch production.

The disadvantage of this batch production is to have one month inventory (as WIP and finished products).

This disadvantage worsens the inventory turnover. And the consideration point is.

Inventory Turnover in one month inventory or the turnover in 10 days (for instance) against the sacrifice of machine (& labour) performance which relates to the investment performance.

The aircraft and the jet-engine industry are the broad range industry.

And there are many suppliers.

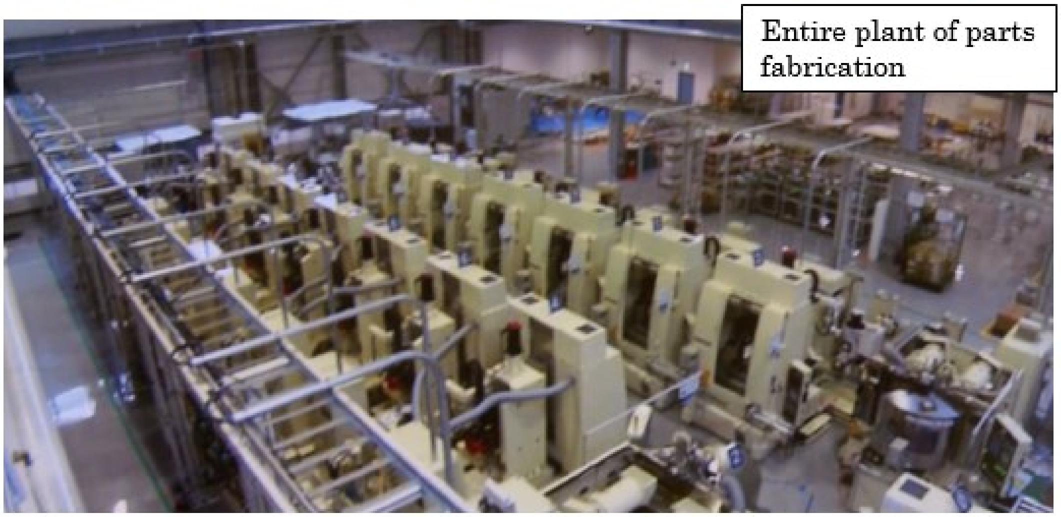
The precise parts and units supplier uses the precise machines.

I have seen the parts supplier of aircraft. And this company also uses lot of NC machines as following photos.

And I remember that the scenery which the NC machines were placed in order was magnificent.

This company also is the batch production.

NC machine group for aircraft parts



Entire plant of parts fabrication

Again thousands millions engine parts should be prepared in the takt time of 11h which the requirement is 2 pieces in a day.
It is possible to use the kanban system in pull, however, is not effective.
Because the production demand (2 in a day) is too small.
If the parts are small and short processing time in the NC machines.
Furthermore if the parts have the process of press, furnace & anneal which are completely batch style.
Is it realistic to do the changeover each 2 pieces?
Yes, it is possible in the process of Furnace & Anneal if there are other parts which are same condition required. The parts which are different kinds but same condition of furnace & anneal are gathered and can be done at once if it is possible to full the furnace.

But in NC and/or press process, it is not realistic. And it is quite understandable that the supplier makes one kind of parts 37 in one batch.
CFM also makes the receiving and inspection in at once (37 pieces each.), because of the time & effort of receiving & inspection procedure.
I said that it is possible to introduce kanban in pull system in the parts production process of jet-engine. But it is not realistic.

Another one story I would present.
The case of a tool maker.
This worldwide famous company gave up to maintain and abandoned the kanban system which he introduced with many effort.
Why?
Was the managerial level low? No. Absolutely not.
The reason was to be increased the WIP and inventory and to be worsen the inventory turnover and the cash-flow.
The reasons are.
  So many kinds of products. And.
  The demands are unpredictable.
  Short lifecycle.

Answer to a question-2.
The question which my students made was
  What is the major cause to fail the introduction of lean management?
Yes, I dare say that many companies failed to introduce and stabilize it.
I know such case many.
Also in the companies, however they say that our company introduced the lean manufacturing successfully, the managerial situation is far from it.
  Can you believe their words that to be introduced successfully?
  They have no systems of Standard time & working standard, kaizen, data gathering and necessary KPI etc. and (as the result), long LT, bad inventory turnover and unsuccessful throughput improvement.
  One of thankful is that the managerial situation was improved a little than before. But the situation and the results are far from the lean management.
So, why fail?
I explain the major 2 causes with through my consulting experience.
  One is the lack of managerial capability.
  One is that the means (TPS) isn't suitable for the lean management of the company.
  ※Lean and TPS are not same.
-1. The gap of the proposal and the Managerial ability (including organizational capability)
  Sometimes I have the offers of joint business or joint project. It is good for me.
  However I need to confirm the fundamental direction to the consultancy job.
  Fundamental direction.
  It is very simple and very natural and is

To listen the "true customer's need".
To make the certain action plan.

I would talk the story of my fledgling era.

When I was a fledgling, I got a client and I made the presentation about TPS and explained how TPS is excellent and my recommendation is innovative. And I supported to introduce some techniques like as Kanban, Andon, Poka-Yoke, SMED ----.

And the introduction activities were finished successfully (superficially). But I found that most of the innovative systems had disappeared or hadn't had the effect which we planned.

Also the fatal phenomenon was that the client wasn't happy because still his true desire hadn't been improved.

Why? I wondered what was wrong.

Was the introduction of some TPS techniques wrong?

No. My proposal and the introduction were never wrong (I thought).

(And I wondered that was it true?)

Why not stabilize?

At the dialogue with my professor of University, I found the answer.

1) The consultancy business shouldn't be irresponsible. (Never be "After us deluge.")

2).For the success of consultancy (support of an innovation),
Not only the (innovative or good) proposal, but also
To support (or to see) the Managerial capability
are essential.

I could understand that this company didn't have the managerial capability to maintain the philosophy and systems of TPS.

After this failure, I became very serious and careful to listen the customer's voice.

He required me to help the introduction of lean.

(His saying Lean was the meaning of TPS.)

Was Lean introduction true demand?

Why did he desire to introduce Lean (in TPS)?

But his true demand was to increase the throughput.

What was the factor of the disincentive to increase Throughput?

Was TPS useful to this company's production process?

Which system was useful for this client?

If teaching TPS, had he sufficient managerial base (managerial capability)?

And I needed to confirm the managerial capability in the diagnosis.

Then I needed to tell the top management as follow.

Yes, it is possible to introduce some parts of TPS, but not possible and not necessary to challenge to entire TPS, because of your business type.

(On the other hand.)
Whatever the introduction of TPS or not, you need to improve the managerial (and organizational) capability.
Whatever you require the introduction of TQM, TPM or Six sigma, the improvement of managerial capability in factory management is essential.
And if you like and (it is suitable), let us introduce some TPS technique like as kanban, Andon etc. in the process of kaizen in the "factory management" improvement.
But I recommend you to forget Lean for a while.
And to establish the sufficient managerial capability, the activity takes more than 3 years. And after this, more than 2 years it is necessary to introduce TPS.
Also the improvement of managerial capability in factory management is one of effective solution to your true demand.

His proposal which the introduction of Lean (in TPS) was innovative, however.
It was not possible to stabilize and to gain the effect.
And it is quite true that the major cause of introduction failure is the "Lack of Managerial Capability and mismatch of means to the Proposal".
I saw many opinion regarding the causes of failure introduction and stability.
And the opinions say that the failure causes are
the lack of top management initiative, culture change etc.
These opinions are correct, but very much childish.
The major causes of lean management introduction failure is the "Lack of the basic factory management capacity".

I wrote and shared the "Factory Management Check List" which has 110 check items in 11 categories which are
Policy Control, Organization and administration, Human resources development, Information gathering and transmission and usage, Standardization, Cost Control System, Factory Management System, Production Control System, Material Control, Quality Control System, Safety Control and Work environment conservation.

For the success of Lean management introduction and the stability, at least 70% of diagnosis result is required.
And once again I would emphasize that
If you want to introduce Lean (in TPS), forget Lean for a while.

Next. I write the Kanban system.
And if I have the time,
We go back to the company (President: C. Wilkins) and the project.
Do you remember this company and project?
This company wishes to introduce the lean management. And we established the project in a factory which is one of pilot factory before the expansion to entire.